4.6 Soil and Vegetation Surveillance

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Soil surveillance provides information on long-term contamination trends and baseline environmental radionuclide concentrations in undisturbed locations (DOE 1994a). Surveillance of natural vegetation provides information on atmospheric deposition of radioactive materials in uncultivated areas and at onsite locations adjacent to potential sources of manmade radioactivity. Accordingly, concentrations of radionuclides in soil and natural vegetation provide a baseline against which unplanned releases can be compared.

Soil and natural vegetation samples have been collected on and around the Hanford Site for almost 40 years. Consequently, a large database has been established that thoroughly documents onsite and offsite concentrations of manmade radionuclides in soil and natural vegetation at specific locations. Because the current Site mission is environmental restoration and cleanup, and because routine plutonium production operations have ceased, the need for continuous soil and natural vegetation surveillance has diminished. As a result, no soil or natural vegetation samples were collected by Pacific Northwest National Laboratory in 1995. Future sampling of soil and natural vegetation will be conducted on an as-needed basis in support of Site cleanup activities and facility operations.

There are several reasons for the reduced need for soil and natural vegetation sampling. Manmade radionuclides with short half-lives have decayed to stable isotopes and are no longer detected. Moreover, radionuclide releases from Hanford in recent years have been small, and therefore, baseline radionuclide concentrations have not changed appreciably for a number of years. Because only natural radionuclides or manmade radionuclides with relatively long half-lives presently are found in soil and vegetation samples, annual sitewide environmental surveillance sampling of soil and vegetation can be less frequent.

Other soil and vegetation sampling by Westinghouse Hanford Company near active facility release points and waste sites on the Site continued in 1995, and results are discussed in Section 3.2, "Near-Facility Environmental Monitoring."

In 1995, two reports were published that addressed radionuclides in soil and natural vegetation: a trend report of soil and vegetation surveillance data from 1983 through 1993 (Poston et al. 1995) and a special vegetation study of strontium-90 and cesium-137 concentrations in Carey's balsamroot (*Balsamorhiza careyana*) and desert parsley (*Lomatium grayi*) collected onsite in 1994 (Poston 1995). These reports are summarized below.

Radionuclide Concentration Trends in Soil and Vegetation 1983-1993

Concentrations of cobalt-60, strontium-90, cesium-137, uranium isotopes, plutonium isotopes, and americium-241 in soil and natural vegetation were evaluated for 1983 through 1993. Natural vegetation consists of the current year's growth of sagebrush and rabbitbrush. Radionuclide concentrations were evaluated to determine whether there were differences between study areas and whether there were changes over time, i.e., trends. Results from each area should not be construed as a characterization of the area. Characterization of radionuclide distribution in these areas was not the objective of the surveillance sampling design.

The data were grouped into five general locations: the 100 Areas, the 200 Areas, the 300 Area, the undeveloped areas onsite (600 Area), and offsite areas. Sampling locations onsite usually were chosen to monitor a specific facility or operational area and were generally selected to maximize the potential to identify elevated concentrations. Hence, slightly elevated concentrations of manmade radionuclides were expected in these areas. Specific observations on differences between study areas are listed below:

- The 100 Areas (primarily around the 100-N Area) had concentrations of cobalt-60 less than or equal to a nominal detection limit of 0.02 pCi/g; concentrations of cobalt-60 in all other study areas were not detected.

- The 200 Areas had slightly elevated concentrations of strontium-90, cesium-137, plutonium-238, plutonium-239,240, and americium-241 in soil compared to the other study areas. These general observations were also reflected in vegetation samples.

- Uranium concentrations were slightly elevated in soil samples from the 300 Area compared to the other study areas.

Over the 11-year study period, concentrations of cobalt-60, cesium-137, uranium isotopes, plutonium isotopes, and americium-241 in soil and natural vegetation did not change. Concentrations of strontium-90 in soil decreased over the study period in all five areas. The decrease was due to radiological decay and a downward migration of strontium-90 from the 1-in. (2.54-cm) soil sampling horizon. Decreasing strontium-90 concentrations were also noted in vegetation samples collected during the study period. Concentrations of other radionuclides in vegetation were consistently below detection and did not allow for evaluation of trends.

The concentrations of the radionuclides measured in soil and vegetation were well below levels considered hazardous to humans or wildlife. In many instances, onsite measurements were comparable to, or less than, offsite measurements. Offsite measurements exceeded onsite measurements in areas that historically received greater amounts of precipitation and consequently, greater amounts of fallout from weapons testing (Perkins and Thomas 1980).

Special Balsamroot and Desert Parsley Study

Traditionally, big sagebrush and rabbitbrush were routinely collected for surveillance activities. A special vegetation study was conducted in 1994 to determine the existing concentrations of strontium-90 and cesium-137 in Carey's balsamroot and desert parsley. These plants were sampled because they represent taxa that have not been sampled routinely in the past and may be of interest to the Tribes and Site stakeholders. The need for this information was driven by the anticipated transfer of the Fitzner/Eberhardt Arid Lands Ecology Reserve to another caretaker. Plant samples were collected on Rattlesnake Mountain on the Arid Lands Ecology Reserve and from land around the 100 and 200 Areas (Figure 4.6.1). Balsamroot leaves and roots were both sampled, but only leaves were collected from desert parsley. Results were compared to concentrations of radionuclides measured in composite samples of sagebrush and rabbitbrush foliage routinely collected in 1994. These data were sorted into onsite and offsite groups.

Radiological Results

Cesium-137 was found only in balsamroot, and almost exclusively in the roots, from all areas sampled (Figure 4.6.2). The concentrations of cesium-137 in balsamroot roots collected from the 200 Areas were greater than concentrations observed in samples collected on the Fitzner/Eberhardt Arid Lands Ecology Reserve. This observation is consistent with observations reported in prior years. Two of fourteen balsamroot leaf samples contained cesium-137 at concentrations slightly above the nominal detection limit (~0.05 pCi/g). The maximum and median onsite concentrations of cesium-137 in balsamroot leaves collected from the 200 Areas were 0.05 (±0.02) and 0.02 pCi/g, respectively. The maximum and median onsite concentrations (sampled outside of nuclear facility boundaries) of cesium-137 in routinely monitored vegetation sampled in 1994 were 0.03 (±0.02) pCi/g and 0.02 pCi/g, respectively. These results show that cesium-137 in the species collected are not elevated relative to cesium-137 concentrations in other desert vegetation that have been monitored historically.

Strontium-90 concentrations in these vegetation samples were highest in samples collected from the Fitzner/Eberhardt Arid Lands Ecology Reserve (Figure 4.6.3). The median concentration of strontium-90 was higher in balsamroot root tissue (0.34 pCi/g) compared to leafy portions of balsamroot (0.08 pCi/g) collected from the Fitzner/Eberhardt Arid Lands Ecology Reserve. Foliage concentrations of strontium-90 were similar to concentrations of strontium-90 associated with composite samples of sagebrush and rabbitbrush routinely collected at offsite locations. For comparison, the maximum concentration of strontium-90 in 1994 vegetation samples was 0.17 (±0.04) pCi/g from the 200 Areas. The median concentration was 0.04 pCi/g. The maximum and median concentrations of strontium-90 collected at offsite locations were 0.07 (±0.02) pCi/g and 0.04 pCi/g, respectively.

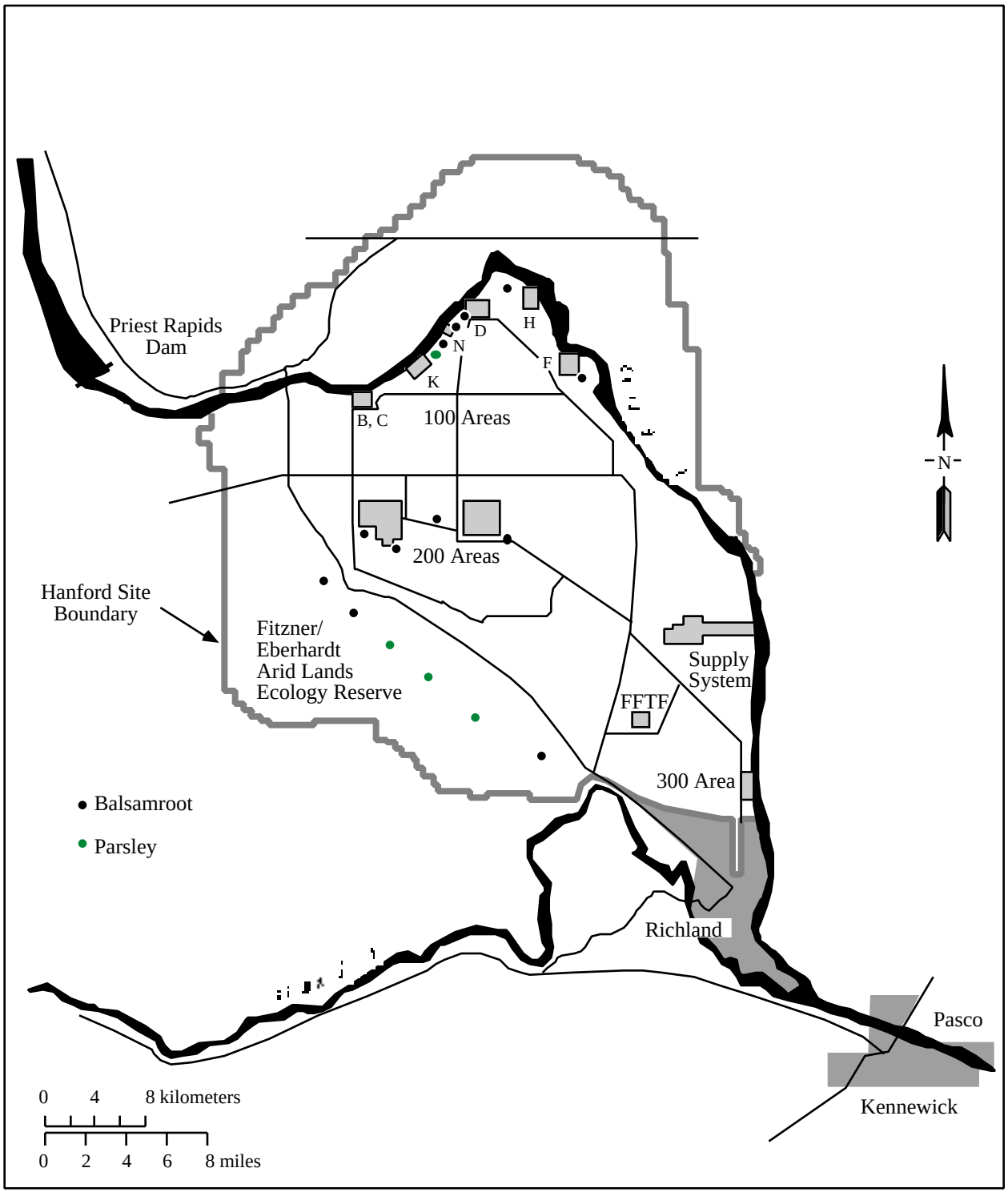

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Figure 4.6.1. Desert Parsley and Balsamroot Sampling Locations

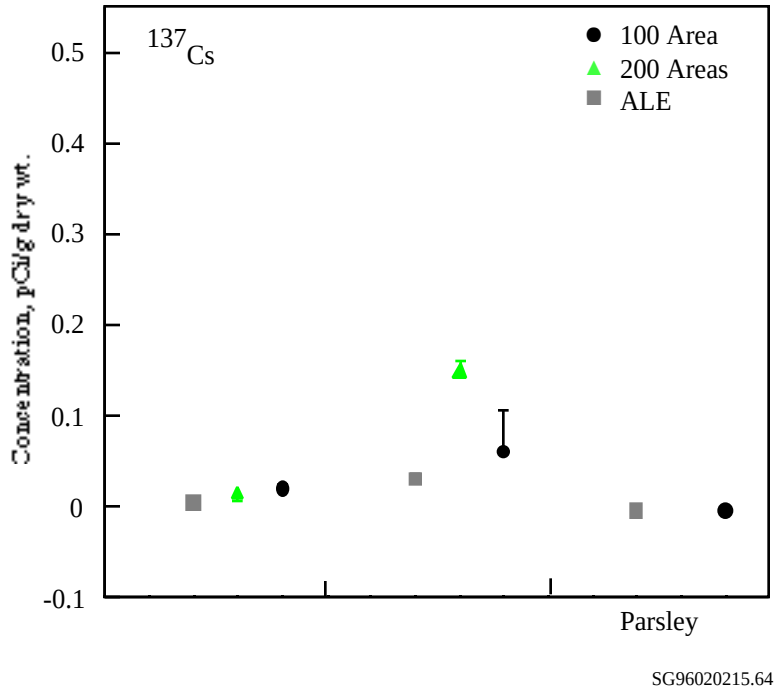

Figure 4.6.2. Cesium-137 Concentrations (maximum, median, and minimum) in Balsamroot and Desert Parsley Collected on the Hanford Site in 1994. As a result of figure scale, some minimum and maximum values are concealed by the point symbol.

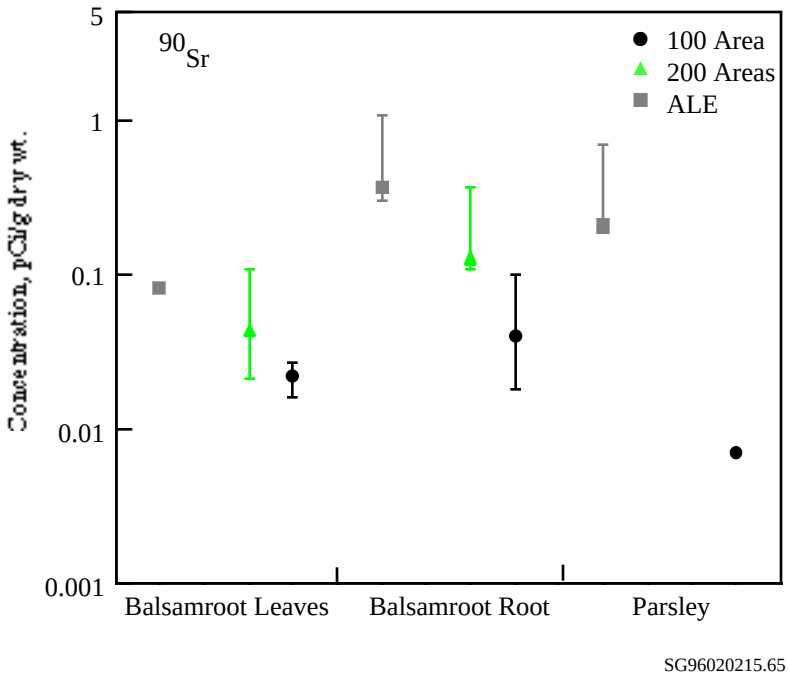

Figure 4.6.3. Strontium-90 Concentrations (maximum, median, and minimum) in Balsamroot and Desert Parsley Collected on the Hanford Site in 1994. As a result of figure scale, some minimum and maximum values are concealed by the point symbol.